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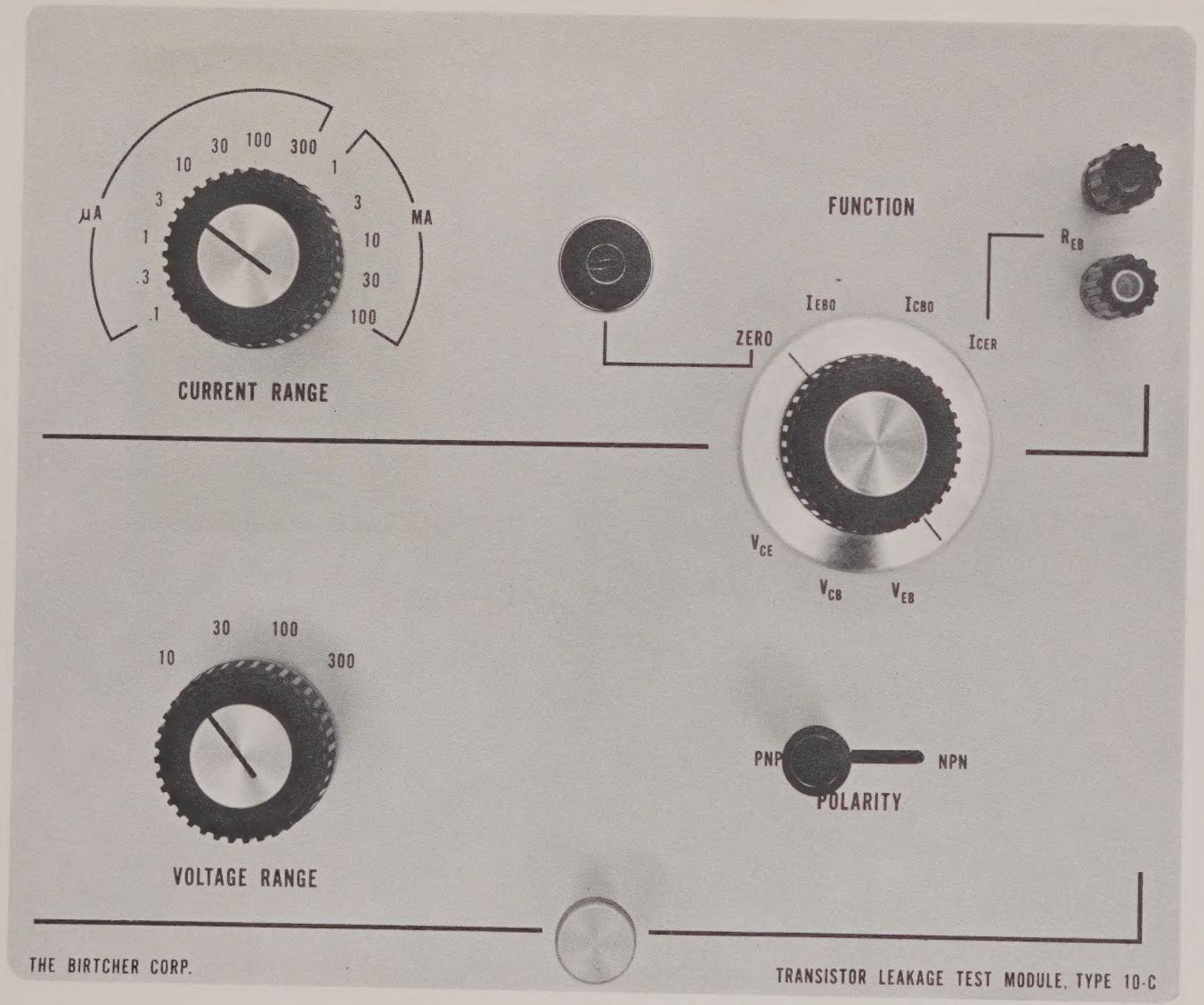
INSTRUCTION MANUAL

THE BIRTCHER CORPORATION INDUSTRIAL DIVISION
745 SOUTH MONTEREY PASS ROAD, MONTEREY PARK, CALIFORNIA

TYPE 10-C

TRANSISTOR LEAKAGE TEST MODULE


μA
1
3
10
30
100
300
MA
CURRENT RANGE
FUNCTION
ZERO
IEBO
ICBO
ICER
REB
VCE
VCB
VEB
10
30
100
300
VOLTAGE RANGE
PNP
NPN
POLARITY
THE BIRTCHER CORP.
TRANSISTOR LEAKAGE TEST MODULE, TYPE 10-C

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SECTION 1
GENERAL DESCRIPTION

1.1 INTRODUCTION

The type 10-C Transistor Leakage Test Module is used with the Eirtcher Model 70 Semiconductor Test Set to provide direct reading of transistor leakages.

A DC Amplifier circuit provides sensitivities to 100 nano-amperes, full scale, for extremely sensitive leakage measurements.

1.2 SPECIFICATIONS

PARAMETERS MEASURED:
I_{CBO}, I_{EBO}, I_{CEO}, I_{CER}, I_{CES}.

LEAKAGE VOLTAGE RANGES:
30, 100, 300, 1000.

LEAKAGE CURRENT RANGES:
0.1, 0.3, 1, 3, 10, 30, 100, 300 MA,
1, 3, 10, 30, 100 MA.

ACCURACY:
$\pm$ 3% of full scale indication.

CONSTRUCTION:
Aluminum alloy chassis, anodized aluminum front panel with three color silk screen markings.

WEIGHT:
6 pounds.

DIMENSIONS:
8½" wide X 7" high X 13" deep.

SECTION 2
OPERATION

2.1 GENERAL

For ease and convenience of operation, the front panel of the Model 70 Semiconductor Test Set, including the type 10-C Transistor Leakage Test Module, has been divided into two functional sections (figure 2-1).

To aid the operator in learning and remembering the basic operation of the instrument, different colors are used for the markings in each section. Black markings refer to Leakage current function, range switch and meter. Red markings refer to leakage voltage controls and meter.

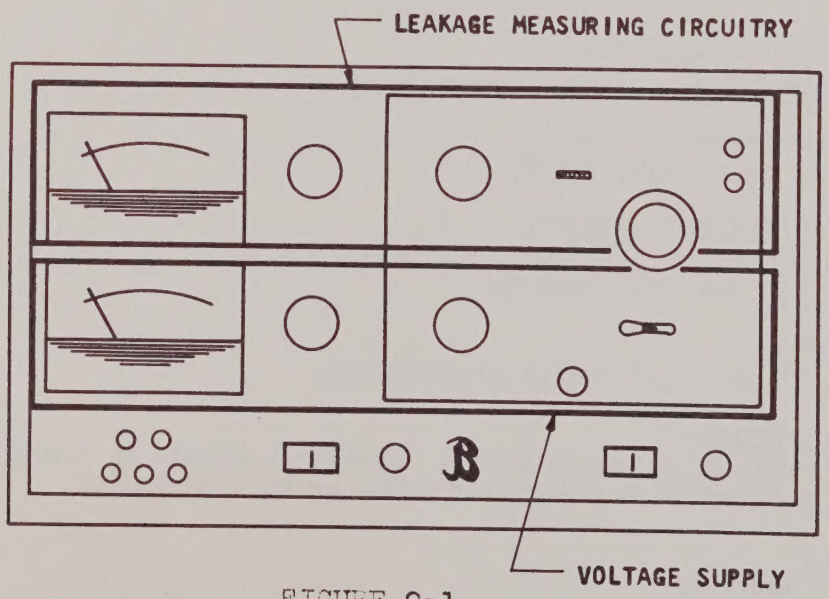


FIGURE 2-1

Front Panel Layout - Model 70 with 10C installed.

2.2 FUNCTION OF CONTROLS AND METERS

CURRENT RANGE Switch
13 Position Rotary Switch provides selection of Leakage Current Meter (upper, Model 70) ranges. Black Markings.

Upper ADJUST control
Not used with the 10-C Test Module.

2.2 FUNCTION OF CONTROLS AND METERS (continued)

Upper METER, Model 70
Dual scale, mirror backed meter; indicates leakage current flowing in transistor under test. Ranges are selected by the CURRENT RANGE SWITCH.

VOLTAGE RANGE Switch
4 Position Rotary Switch provides selection of voltage supply and meter (lower, Model 70) ranges. Red Markings.

Lower ADJUST control
Uncalibrated control used to adjust voltage applied to transistor under test. Red Markings.

Lower METER, Model 70
Dual scale, mirror backed meter; indicates voltage applied to transistor under test. Ranges are selected by VOLTAGE RANGE switch.

POLARITY
2 Position Lever Switch used to reverse power supply and meter polarities for testing PNP or NPN transistors.

FUNCTION
4 Position Rotary Switch provides selection of leakage parameter to be measured; also provides means of shorting input to DC Amplifier for zeroing leakage current meter after warm-up.

ZERO
Potentiometer screw driver adjusted, used for adjusting leakage current meter after warm-up.

R_{EB} Terminals
Binding posts, provide connection to emitter and base of test transistor when FUNCTION switch is in I_{CER} position.

2.3 INITIAL TURN ON AND WARM-UP

1. Turn both ADJUST controls full counter-clockwise.
2. Set FUNCTION switch in the ZERO position.
3. Put POWER switch in on position.
4. After a warm-up period of 1 to 2 minutes, adjust CURRENT meter (upper Model 70) to zero with ZERO adjust control.

2.3 INITIAL TURN ON AND WARM-UP (continued)

CAUTION!

In order to properly test present day transistors, high voltage-high current power supplies must be used. The type 10-C transistor leakage test module used with the Model 70 Semiconductor Test Set provides voltages up to 300 volts at 100 milliamperes. Great care must be taken when working with voltages of this magnitude; carelessness could result in painful or serious injury or a fatality.

2.4 LEAKAGE TEST

1. Set POLARITY switch to type of transistor to be tested.
2. Set FUNCTION switch to leakage parameter to be measured.
3. Set VOLTAGE RANGE switch to desired test range.
4. Set CURRENT RANGE switch to expected leakage range.
5. Depress TEST switch.
6. Turn lower ADJUST control until desired test voltage is indicated on the VOLTAGE meter (lower, Model 70).
7. Read leakage current on CURRENT meter (upper, Model 70).

NOTES:

1. Terminals have been provided for connecting an external resistor or shorting bar between base and emitter for I_{CER} or I_{CES} tests. These terminals are connected only when the FUNCTION switch is in the I_{CER} position.
2. Over currents caused by shorted or leaky transistors will cause the voltage applied to the transistor to be removed. When this condition exists, the RESET lamp will light. To restore operation, release the TEST switch.

SECTION 3
THEORY OF OPERATION

With the type 10-C Test Module, the transistor is connected as shown in the Block Diagram, (Figure 3-1).

Test voltage is supplied by the voltage supply. Polarity of voltage applied is determined by the POLARITY switch. Voltage is applied to transistor terminals selected by the FUNCTION switch.

Leakage current is measured by measuring the voltage developed across the current sensing resistors. This voltage is amplified approx. 2⅔ times and applied to the leakage current meter.

Circuit guarding shunts all stray leakage currents in the wiring to ground, so that leakage in wiring does not flow through the current sensing resistors.

Protection of the voltage supply from over currents is provided by feeding the voltage applied to the leakage current meter circuit to the protection amplifier. The amplifier activates a relay to remove the test voltage from the transistor, if the current exceeds approx. 1-1/3 times full scale current on the current meter.

Voltage applied to the transistor is measured by a voltmeter with the low side returned to the second input of the differential amplifier. The amplifier feedback circuitry is arranged so that the voltage on this input is equal to the voltage developed across the current range resistor. The advantage of this arrangement is that no voltmeter current flows through the current sensing resistors.

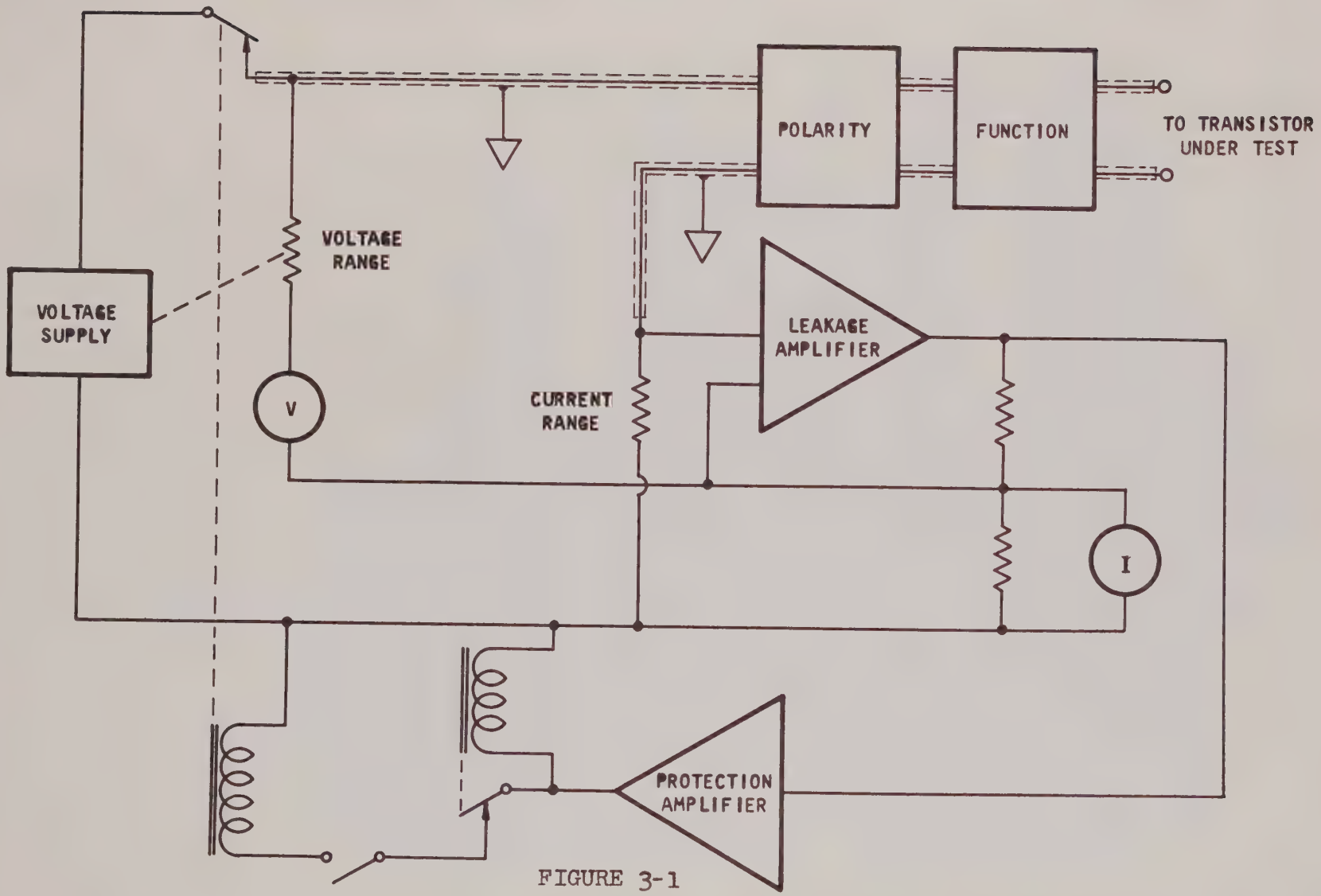


FIGURE 3-1

FUNCTIONAL BLOCK DIAGRAM, Model 70 with 10C installed.

SECTION 4
CIRCUIT DESCRIPTION

4.1 VOLTAGE SUPPLY

The voltage supply provides variable voltages to the transistor under test.

Variable transformer T104 (lower, ADJUST control) supplies 60 cycle AC to the primary of T103. Secondary windings on T103 are selected by S203 for proper voltage output. Voltage selected by S203 is full wave rectified by Diodes D201 through D204 and filtered by Capacitors C201, C202 and Choke L201.

The positive output is connected through contacts on the power control relay to Current limiting resistors R238 to R241 as selected by S201C. The voltage on the common side of the current limiting resistors is connected through S203 (FUNCTION) to the POLARITY switch S204A.

The negative output is connected to ground. Negative voltage flows through the current sensing resistors R212 to R224 to the other side of the POLARITY switch (S204B). The current sensing resistors R212 to R224 are selected by the CURRENT RANGE switch S202.

Voltage from the POLARITY switch is applied thru the FUNCTION switch S203 to the Test Terminals.

4.2 LEAKAGE CURRENT AMPLIFIER

The leakage current amplifier is a differential input DC coupled amplifier.

Voltage developed across the current sensing resistors is applied to one grid of differential amplifier V203. The plate of V203A is DC coupled to the grid of V204A by a neon glow lamp N201. The plate of V207A is DC coupled by N202 to the grid of cathode follower output stage V204B. A potentiometer R226 (ZERO) is used for balancing the amplifier inputs. Gain of the amplifier stage is stabilized by feedback resistors R235 and R236 to approx. +2.5 times.

The amplifier output is connected to the protection amplifier input. The voltage developed across R235 is applied to the current meter M102. Calibration adjustment of M102 is provided by R242.

4.3 VOLTMETER

The voltmeter is used to measure the voltage applied to the transistor under test.

The voltage supply positive output voltage is applied to the voltmeter range resistors R203 to R206. The proper range resistor is selected by S201 (VOLTAGE RANGE). The voltage on the common of S201 is applied to M101+. The negative input to M101 is connected to R235.

4.4 PROTECTION CIRCUIT

The protection circuit consists of essentially two sections: The protection amplifier including the sensing and control portions and the power control relay K201.

Under normal conditions over-load relay K101 remains de-energized whenever the TEST RESET switch S102 is operated to TEST. The contacts of K101 complete the circuit from the DC output voltage of rectifiers D101 and D102 to the coil of relay K201 energizing the relay. With K201 energized, the voltage supply is connected to the transistor test terminals providing operating voltages to the transistor being tested. The output from the leakage amplifier is applied to R102 which in turn charges C102. When the voltage between the emitter and base of unijunction Q102 exceeds approximately 4 volts (1-1/3 times full scale on the leakage current meter), it goes into a negative resistance state discharging C102 thru the gate of the controlled rectifier Q101. This triggers Q101 into a conducting state, energizing K101 and causing over-load indicator DS102 to come on. When K101 is energized, its contacts open and remove power from the coil of K201, opening the contacts of this relay and thus removing potentials from the transistor being tested.

When the over-load condition is corrected, S102 must momentarily be opened (operated to RESET) then again closed (TEST) to restore normal operation.

4.5 AUXILIARY POWER

Transformer T101 is used to convert 115 VAC line voltage to voltages for plate and filament supplies.

Secondary windings 3 thru 5 is connected to D202 A thru D to supply high voltage positive and negative full wave rectified output. C205 A and B and R207 form a capacitor RC filter for the positive supply. Output voltage is regulated by V201. C204, C205 and R208 form a capacitor input RC filter for the negative supply. The negative supply is regulated by V202.

Amplifier filament voltage is supplied by secondary windings 6, 7 and 8 on T101.

SECTION 5

MAINTENANCE

5.1 INSTRUCTION MANUAL

A Birtcher Instruction Manual usually contains hand-made changes to diagrams and parts lists and sometimes texts. These changes are generally appropriate only to the instrument the manual was prepared for. The hand-made corrections show changes to the instrument that have been made after the printing of the manual.

There is a serial number on the warranty page of this manual. This is the serial number of your instrument. Be sure the manual number matches the instrument number when you order parts.

NOTE: Always include the instrument type and serial number in any correspondence regarding the instrument.

5.2 REPLACEMENT PARTS

5.2.1 Standard Components

Birtcher will supply replacement components at current net prices. However, since most of the components are standard electronic and radio parts, you can probably obtain them locally faster than we can ship them to you from the factory in Monterey Park, California. Be sure to consult the parts list to see what tolerances are required.

5.2.2 Selected Components

We specially select some of the components whose values must fall within prescribed limits. By sorting through our regular stocks the components so selected will have standard retma color coding showing the value and tolerance of the stock they were selected from, but they will not in general be replaceable from dealer stock.

5.2.3 Birtcher Manufactured Parts

Birtcher manufactures almost all of the mechanical parts and some of the components used in the instrument. If you order a mechanical part be sure to describe the part completely to prevent any unnecessary delay in filling your order. When you have any questions about mechanical parts or Birtcher manufactured components, contact our nearest field sales representative or write to the service department at the factory in Monterey Park, California.

5.3 REMOVAL AND REPLACEMENT OF PARTS

The procedures required for replacement of most parts in the type 10-C are obvious. Detailed instructions for their removal are not required. Other parts, however, can be best removed if a definite procedure is followed. Instruction for the removal of some of these parts are contained in the following paragraphs.

5.3.1 Replacement of Switches

Methods of removal of defective switches, are, for the most part, obvious and only a normal amount of care is required. Single wafers are normally not replaced on the switches used in the type 10-C and if one wafer is defective, the entire switch should be replaced. Switches may be ordered from Birtcher either wired or unwired as desired.

5.3.2 Replacement of PC Board Components

Some components in the 10-C are mounted on a printed circuit board. To avoid damage to the PC board when replacing components the following precautions should be observed:

Use a low power soldering iron (50 watts maximum).

Use only a high quality rosin core solder. NEVER A PASTE FLUX. After soldering, clean off any excess flux.

When replacing components with multiple mounting pins such as transistors, potentiometers, etc., it will be necessary to lift each pin slightly, working around the components several times until it is free.

5.4 CALIBRATION

5.4.1 Preliminary

The type 10-C test module is a stable instrument and should not require frequent calibration. However, a periodic check of operation is desireable from the standpoint of preventative maintenance. The following equipment is necessary for calibration of the 10-C Test Module.

5.4.1 Preliminary (continued)

1. Birtcher Model 70 Basic Unit.
2. Birtcher type B5536 Module Connector Cable.
3. Precision DC Microammeter, 1 ma. f.s., 1% accuracy, Simpson Model 1702, 1703 or equivalent.
4. Precision DC Voltmeter to cover range from 10 to 300 volts with 1% accuracy, Simpson Model 1700 or equivalent.

Connect the 10-C Test Module to the Model 70 Basic Unit with the B5536 Module Connector Cable. Mechanically zero all meters.

5.4.2 Current Meter Calibration

1. Place front panel controls in the following positions:

ADJUST controls	CCW
POLARITY	PNP
CURRENT RANGE	1 ma.
VOLTAGE RANGE	10 volts
FUNCTION	zero

2. Turn power on and allow 5 minutes warm-up.
3. Zero current meter with zero adjustment control.
4. Connect precision microammeter (1 MA RANGE) between E (-) and B (+).
5. Turn FUNCTION to I_{EBO} position.
6. Depress TEST SWITCH.
7. Turn lower ADJUST control for 1 ma. indication on external meter.
8. ADJUST R242 for full scale deflection on M102 (upper, Model 70).

5.4.3 Voltmeter Check

1. Place front panel controls in the following positions.

ADJUST control	CCW
POLARITY	PNP
CURRENT RANGE	100 ma.
VOLTAGE RANGE	10 volts
FUNCTION	zero

2. Turn Power on and allow 5 minutes warm-up.
3. Zero the current meter with the ZERO ADJUSTMENT control.

5.4.3 Voltmeter Check (continued)

4. Connect the precision voltmeter (10 volt range) between "B" (+) "E" (-) terminals.

5. Switch the FUNCTION switch to the I_{EBO} position.

6. Depress the TEST switch.

7. Rotate lower adjust control for 10 volt indication on external volt meter. The lower meter on the model 70 should read full scale.

8. Repeat step 7 for 30, 100 and 300 volt ranges.

SECTION 6

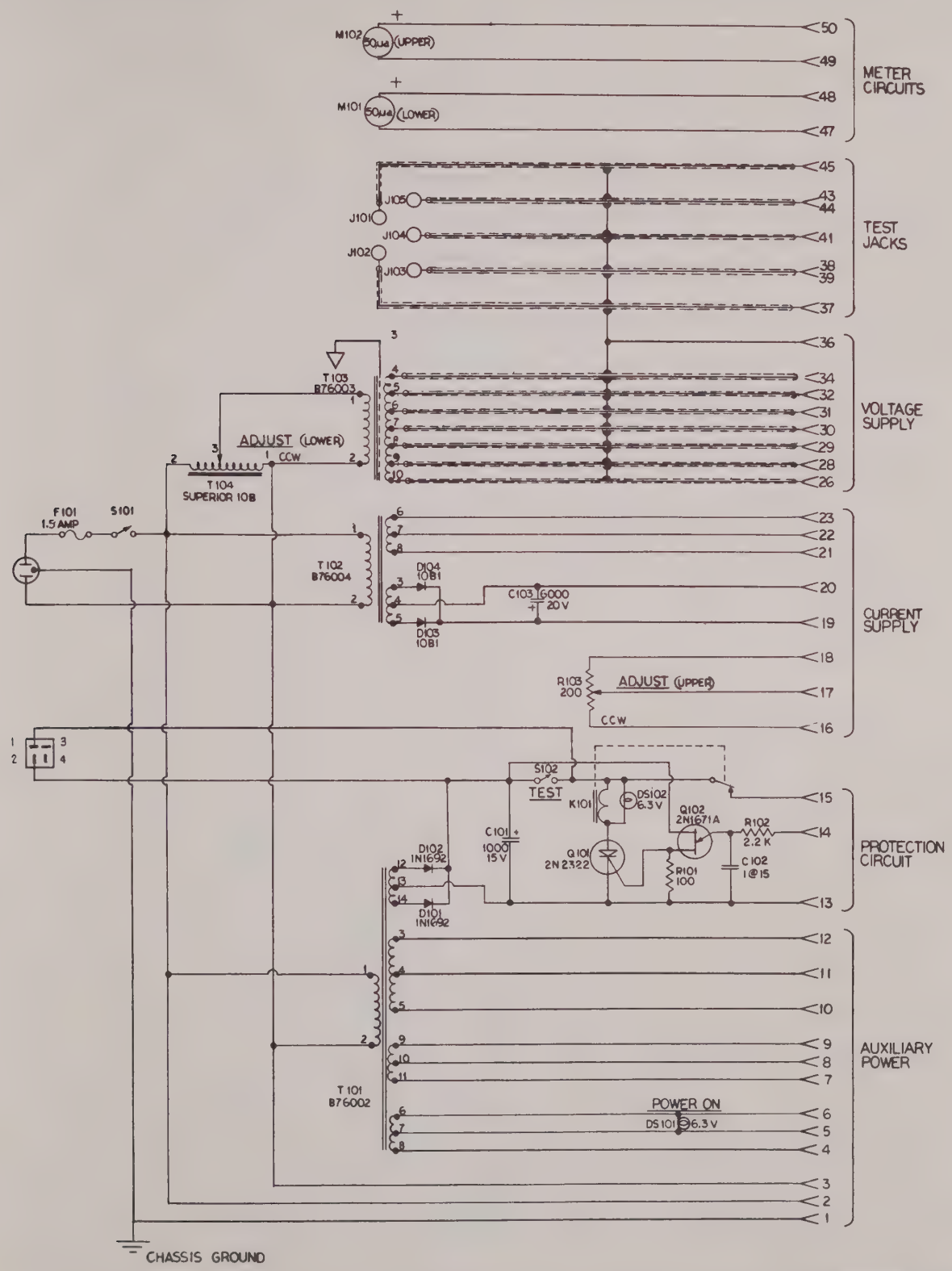
PARTS LIST

CAPACITORS	DESCRIPTION	PART NUMBER
C 201	150 MFD @ 350 VDC Electrolytic	104-003
C 202	150 MFD @ 350 VDC Electrolytic	104-003
C 203	40-40 MFD @ 300 VDC Electrolytic	104-100
C 204	40 MFD @ 350 VDC Electrolytic	104-012
C 205	40 MFD @350 VDC Electrolytic	104-012
C 206	.1 MFD @ 500 VDC Disc.	100-076
C 207	.1 MFD @ 500 VDC Disc.	100-076
C 208	.1 MFD @ 500 VDC Disc.	100-076
C 209	.1 MFD @ 500 VDC Disc.	100-076
CHOKE		
L 201	1 Hy @ 100 MA Inductor	B76057
DIODES		
D 201	SCBR7A	740-007
D 202	Bridge 600 PIV.	740-008
D 203	1N1692	740-006
RELAY		
K 201	DPDT 6 VDC	540-001
LAMPS		
N 201	55ST2S Neon	340-001
N 202	55ST2S Neon	340-001
RESISTORS		
R 201	10K, 10 Watt Wirewound	553-128
R 202	1K, 10 Watt Wirewound	553-100
R 203	6M, 1% Den. Carb.	551-076
R 204	2M, 1% Den. Carb.	551-075
R 205	597K, 1% Den. Carb.	551-092
R 206	198K, 1% Den. Carb.	551-089
R 207	180 Ohm	550-027
R 208	180 Ohm	550-027
R 209	10K, 5 Watt Wirewound	553-127
R 210	10K, 5 Watt Wirewound	553-127
R 211	82K, 1 Watt	550-131
R 212	10M, 1%	551-077
R 213	5M, 1%	551-095
R 214	1.11M, 1%	551-096
R 215	344.5K, 1%	551-097

RESISTORS (cont.)	DESCRIPTION	PART NUMBER
R 216	101K, 1%	551-098
R 217	33.4K, 1%	551-063
R 218	10K, 1%	551-026
R 219	3.33K, 1%	551-031
R 220	1K, 1%	551-001
R 221	333 Ohm, 1%	551-002
R 222	100 Ohm, 1%	551-003
R 223	33.3 Ohm, 1% Wirewound	553-054
R 224	10 Ohm, 1% Wirewound	553-025
R 225	18K	550-104
R 226	10K, Variable	554-029
R 227	18K	550-104
R 228	2.2M	550-176
R 229	1M	550-175
R 230	470K	550-152
R 231	2.2M	550-176
R 232	220K	550-150
R 233	2.2M	550-176
R 234	1M	550-175
R 235	10K	550-101
R 236	15K	550-105
R 238	335 Ohm, 5 Watt Wirewound	553-101
R 239	100 Ohm, 2 Watt	550-030
R 240	33 Ohm	550-002
R 241	10 Ohm	550-001
R 242	5K, 2 Watt, Variable Wirewound	555-050
R 243	15K, 5%	550-103

SWITCHES		
S 201	Rotary, 3 Pole, 4 Position (NS)	A76078
S 202	Rotary, 1 Pole,13 Position (NS)	A76079
S 203	Rotary, 5 Pole, 4 Position (NS)	A76080
S 204	Lever, 2 Pole, 2 Position (NS)	870-002

TUBES		
V 201	0A2	910-000
V 202	0B2	910-001
V 203	12AT7A	910-155
V 204	12AX7A	910-150



4 RESISTANCES IN OHMS.
3. UNDERLINED CONTROL DESIGNATIONS APPEAR ON FRONT PANEL
2 CAPACITANCES IN µfd.
1. RESISTORS ½W, ±10%, CARBON.

NOTES: UNLESS OTHERWISE SPECIFIED.

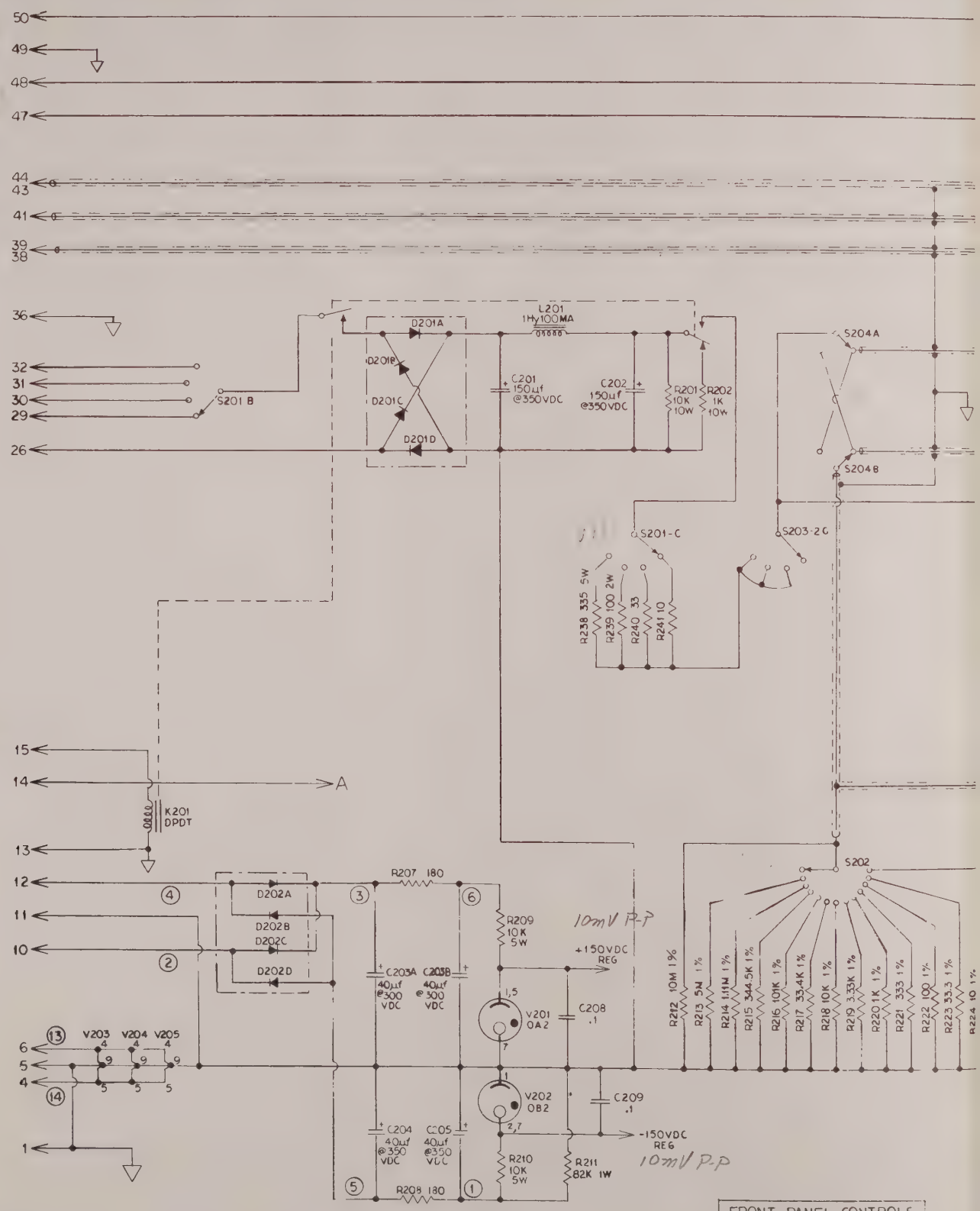
REV.	DESCRIPTION	DATE	DRWN.	APPD.
D	GROUNDED TERMINAL 3 ON T103	3-1-64	E.B.	RM
C	REMOVED R104, R105 & D105. REV. PROTECT. CIRC., R101 WAS 220Ω R102 WAS 100Ω, C102 WAS 5, Q101 WAS T1145A0	4-29-63	E.B.	RM
B	ADDED D105 IN118	3-18-63	L.M.	
A	Q102 WAS 2N1761, R102 WAS 100K, C102 WAS .25, NOTE #4 ADDED. F101 WAS 1 AMP.	2/22/63	A.V.K.	

REVISIONS

BIRTCHER CORP/INDUSTRIAL DIVISION

MODEL 70
SEMICONDUCTOR TEST SET
BASIC UNIT
SCHEMATIC

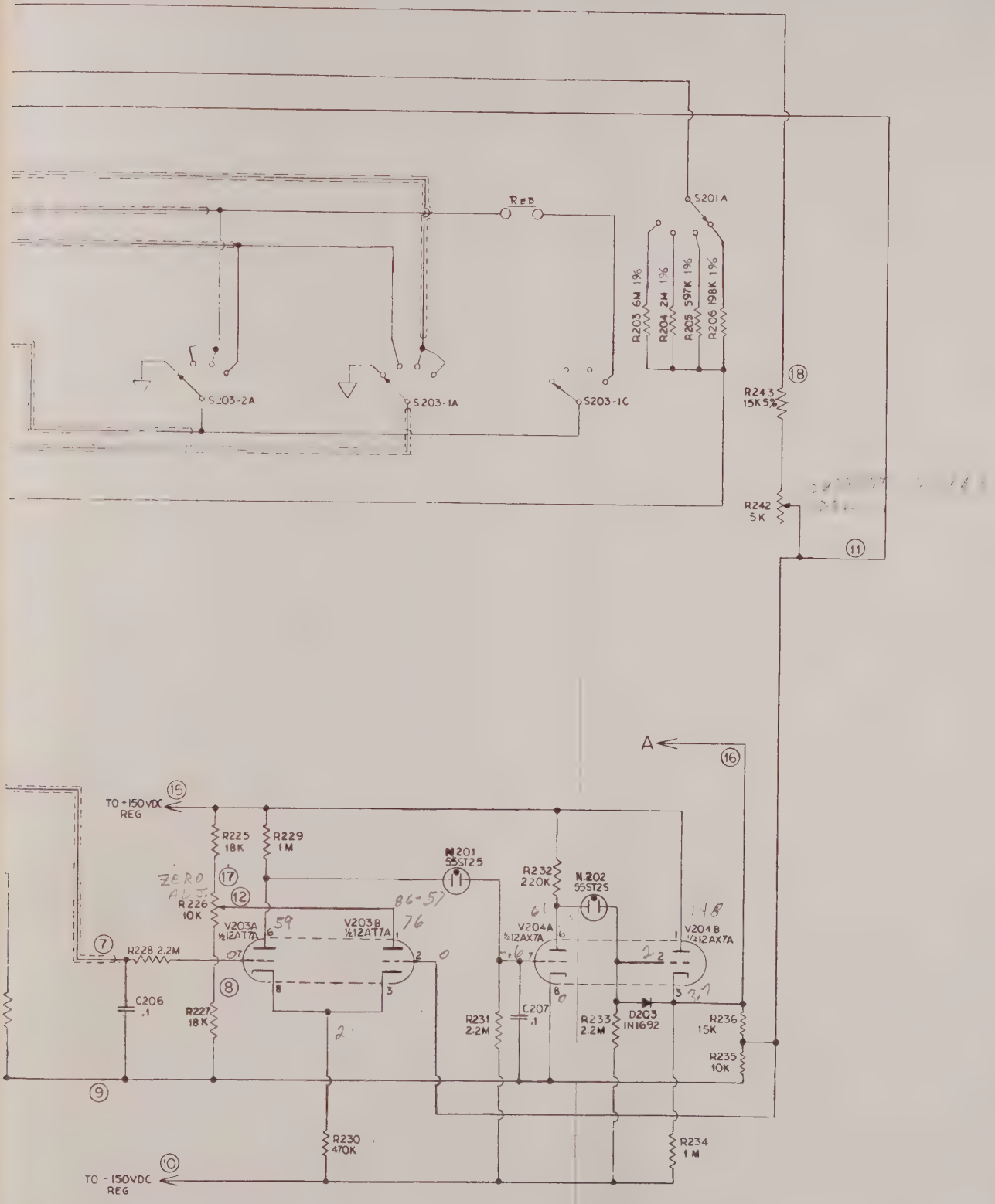
DRWN: A.V.K. DATE: 6.25.62. | APPD: RM DATE: 6.26.62 | REV. D



FRONT PANEL CONTROLS	
S201	VOLTAGE RANGE
S202	CURRENT RANGE
S203	FUNCTION
S204	POLARITY

6. P.C. BOARD NO'S: ◯
5. ALL RESISTANCES IN OHMS.
4. ALL CAPACITORS 200 V.
3. ALL CAPACITANCES IN µµfd.
2. ALL RESISTORS ½ W., 10% CARBON.
1. ALL ROTARY SWITCHES SHOWN IN CCW POSITION.

NOTES: UNLESS OTHERWISE SPECIFIED.



BIRTCHER CORP./INDUSTRIAL DIVISION

MODEL 10-C
SCHEMATIC

ISSUE	DESCRIPTION	DATE	DRWN	APP'D
H	REVISED	4-15-64	E.B.	RM

REVISIONS

DRAWN: A.V.K.
DATE: 12.7.62

APPR'D:
DATE:

REV. H

WARRANTY

All our products are warranted against defects in materials and workmanship for one year from the date of shipment. Our obligation is limited to repairing or replacing parts which prove to be defective during the warranty period. We are not liable for consequential damage.

For assistance of any kind including help with instruments under warranty, contact your authorized Birtcher sales representative for instructions. Give full details of the difficulty and include the instrument model and serial number. Service data or shipping instructions will be promptly sent to you. There will be no charge for repair of instruments under warranty, except transportation charges. Estimates of charges for non warranty or other service work will always be supplied if requested before work begins.

Serial Number 10C_____